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ANSARI, TAHMINA N	

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Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Office Action Summary	Application No. 10/597,039	Applicant(s) ZHAO, LUYIN	
	Examiner TAHMINA ANSARI	Art Unit 4146	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on 07 July 2006.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) 1-19 is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) 1-19 is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☒ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on 07 July 2006 is/are: a)☐ accepted or b)☒ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)

2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)

3) ☒ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date 07/07/2006.

4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .

5) ☐ Notice of Informal Patent Application

6) ☐ Other: _____.

DETAILED ACTION

1. Claims 1-19 are pending in this application.

Specification

Drawings

2. The drawings are objected to under 37 CFR 1.83(a) because they fail to show labels for the appropriate structures in the flow diagrams as described in the specification. Applicant submitted drawings on July 7, 2006, containing 3 pages consisting of Figures labeled 1-4. Figures 1 and 2 consist of flow diagrams which lack labels and are unclear as to what steps or to which components it refers. Any structural detail that is essential for a proper understanding of the disclosed invention should be shown in the drawing. MPEP § 608.02(d). Corrected drawing sheets in compliance with 37 CFR 1.121(d) are required in reply to the Office action to avoid abandonment of the application. Any amended replacement drawing sheet should include all of the figures appearing on the immediate prior version of the sheet, even if only one figure is being amended. The figure or figure number of an amended drawing should not be labeled as "amended." If a drawing figure is to be canceled, the appropriate figure must be removed from the replacement sheet, and where necessary, the remaining figures must be renumbered and appropriate changes made to the brief description of the several views of the drawings for consistency. Additional replacement sheets may be necessary to show the renumbering of the remaining figures. Each drawing sheet submitted after the filing date of an application must be labeled in the top margin as either

"Replacement Sheet" or "New Sheet" pursuant to 37 CFR 1.121(d). If the changes are not accepted by the examiner, the applicant will be notified and informed of any required corrective action in the next Office action. The objection to the drawings will not be held in abeyance.

Claim Rejections - 35 USC § 101

3. 35 U.S.C. 101 reads as follows:

> Whoever invents or discovers any new and useful process, machine, manufacture, or composition of matter, or any new and useful improvement thereof, may obtain a patent therefor, subject to the conditions and requirements of this title.

4. Claim(s) 13-18 are rejected under 35 U.S.C. 101 as not falling within one of the four statutory categories of invention. While the claims recite a series of steps or acts to be performed, a statutory "process" under 35 U.S.C. 101 must (1) be tied to another statutory category (such as a particular apparatus), or (2) transform underlying subject matter (such as an article or material) to a different state or thing . The instant claims neither transform underlying subject matter nor positively tie to another statutory category that accomplishes the claimed method steps, and therefore do not qualify as a statutory process. In order for a process to be "tied" to another statutory category, the structure of another statutory category should be positively recited in a step or steps significant to the basic inventive concept, and NOT just in association with statements of intended use or purpose, insignificant pre or post solution activity, or implicitly.

Claim 13 is directed towards a method for comparing a test image to a collection of reference images to identify reference images that are similar to the test image comprising of three elements. The claim neither transforms the underlying subject matter, nor positively ties to another statutory category, such as a particular apparatus or machine, that accomplishes the claimed method steps and therefore does not qualify as a statutory process under 35 U.S.C 101. Likewise, claims 14-18 are dependent upon claim 13 and fail to overcome the problem recited for claim 13.

5. Claim 19 is rejected under 35 U.S.C. 101 because the claimed invention is directed to non-statutory subject matter.

Claim 19 defines a computer program product having a computer readable-medium embodying functional descriptive material (i.e., a computer program executable by a processor). However, the claim does not define a "computer-readable ***storage*** medium or computer-readable memory" and is thus non-statutory for that reason (When functional descriptive material is recorded on some computer-readable ***storage*** medium it becomes structurally and functionally interrelated to the medium and will be statutory in most cases since use of technology permits the function of the descriptive material to be realized). The scope of the presently claimed invention encompasses products that are not necessarily stored on computer readable medium, and thus NOT able to impart any functionality of the recited program. The examiner suggests amending the

claims to embody the program on “computer-readable ***storage*** medium” or equivalent. The specification does NOT define the computer readable medium as a “signal”, “carrier wave”, or “transmission medium” which are deemed non-statutory. Any amendment to the claim should be commensurate with its corresponding disclosure.

Claim Rejections - 35 USC § 103

6. Claims 1-19 are rejected under 35 U.S.C. 103(a) as being unpatentable over Takeo (US Patent 6,272,233 B1) in view of Sahiner et al., (“Design of a high-sensitivity classifier based on a genetic algorithm: application to computer-aided diagnosis”, Phys. Med. Biol. 43 (1998) p. 2853-2871), hereby referred to as “Sahiner”.

Consider Claim 1:

Takeo teaches “An apparatus for comparing a test medical, multi-featured image of a tumor” **(Takeo, column 6, lines 14-21, column 7, lines 6-49)** “to a collection (204) of reference medical, multi-featured images of tumors determined to be malignant, or to a collection (204) of reference medical, multi-featured images of tumors determined to be non -malignant (112, 220)” **(Takeo, column 8, lines 12-61, equation 8, steps 1-3; collection of featured images of tumors determined to be non-malignant [pattern classification between the normal pattern of i=1] or determined to be malignant [and the abnormal**

pattern of i=2]), “to identify ones of the reference images that are similar feature-wise to the test image, each of the features of the test and medical images having respective values” **(Takeo, column 8, lines 46-67, column 9, lines 1-12)**, “said apparatus comprising a processor (100) configured for designating one of the two collections” **(Takeo, column 19, lines 24-51, column 20, lines 22-66, Figures 1 and 2; processor [processing means] for designating one of the two collections [prospective abnormal pattern detecting apparatus, comparison means])**, “applying a distance algorithm to alter ones of the groups (228) and to determine which of the groups is at a minimum distance to the test image based on said values (216, 220)” **(Takeo, column 34, lines 10-67, column 35, lines 1-25, Figure 13; a Mahalanobis distance algorithm is applied to alter the groups [pattern classes for both normal and abnormal patterns] to determine which of the groups is at a minimum distance to the test image)**.

Takeo does not teach “selecting reference images from the designated one to form respective groups of the selected images (208)”, “applying a genetic algorithm to alter ones of the groups (228) and to determine which of the groups is at a minimum distance to the test image based on said values (216, 220)”. Sahiner, however, does teach “selecting reference images from the designated one to form respective groups of the selected images (208)” **(Sahiner, section 2.1, paragraph 2, lines 1-13, section 2.2, paragraph 1, lines 1-7, section 2.4, paragraphs 1-2, Figures 2 and 3; selecting reference images [255**

mammograms with 128 benign and 127 malignant] to form respective groups [benign and malignant] of the selected images and designate a subset [select a subset of features from the feature pool for the classification task]), "applying a genetic algorithm to alter ones of the groups (228) and to determine which of the groups is at a minimum distance to the test image based on said values (216, 220)" **(Sahiner, section 2.51-2.52, section 2.6, paragraphs 4-5)**.

It would have been obvious to a person with ordinary skill in the art at the time of the invention to combine the teachings of Takeo with Sahiner in order to apply a "GA-based method to design a high-sensitivity classifier for CAD applications" that overcomes the accuracy issues with traditional distance-based algorithms, and that can detect masses with an accuracy "significantly higher than that of LDA_{sfs} above a true-positive fraction of 0.95" and which can provide accurate assessment of benign masses without missing malignancies **(Sahiner, section 5, paragraph 1)**.

Consider Claim 2:

The combination of Takeo and Sahiner teaches "the apparatus of claim 1, wherein said selecting forms a set of said groups and wherein said applying iteratively derives (228), from groups of the set, based on distances from the test image to respective ones of the groups of the set and until a stopping criterion is met (224), new groups of the set" **(Takeo, column 34, lines 10-67, column 35,**

lines 1-25, Figure 13; Sahiner, section 1, paragraph 4, lines 1-13, section 2.4, paragraphs 1-3; Both Takeo and Sahiner teach the use of distance algorithms. Takeo teaches iteratively applying a Mahalanobis distance algorithm to form a set of groups [pattern classes for both normal and abnormal patterns]; Sahiner teaches the use of linear discriminant analysis with stepwise feature selection [LDA_{sfs}] where one feature is entered into or removed from the selected feature pool at each step for analyzing its effect on the selection criterion, and further teaches the use of Wilks lambda or the Mahalanobis distance algorithm as commonly used measures. Sahiner also teaches using [LDA_{sfs}] by applying the Wilks lambda algorithm wherein the algorithm derives new groups of the set from the current groups of the set [at step s of the algorithm available features are entered into the selected feature pool one at a time and those already selected are removed one at a time] based on distances from the test image to respective ones of the groups of the set [significance of the change is rated and those that are most significant features are kept] until a stopping criterion is met [no more feature can satisfy the criteria for either being added or removed]).

Consider Claim 3:

The combination of Takeo and Sahiner teaches “the apparatus of claim 2, said processor being configured to compute the distances as Mahalanobis distances

(216)" **(Takeo, column 34, lines 10-67, column 35, lines 1-25, Figure 13; a Mahalanobis distance algorithm is applied to alter the groups [pattern classes for both normal and abnormal patterns] to determine which of the groups is at a minimum distance to the test image)**.

Consider Claim 4:

The combination of Takeo and Sahiner teaches "the apparatus of claim 2, said apparatus being configured to perform the iterative deriving by calculating, based on said values and for each of the groups" **(Takeo, column 32, lines 47-67, column 33, lines 1-67, column 34, lines 1-10, Figure 13; The combination of Takeo and Sahiner teaches calculating five index values which represents the variance, difference entropy, correlation, inverse difference moment, sum entropy to help determine if a mass is a true or false positive)** "for which a Mahalanobis distance has not already been calculated (216, 220), a Mahalanobis distance between the test image and that group" **(Takeo, column 34, lines 10-67, column 35, lines 1-25, Figure 13; The combination of Takeo and Sahiner teaches iteratively deriving by calculating the Mahalanobis distance between the test image and that group [pattern classes for both normal and abnormal patterns] to determine which of the groups is at a minimum distance to the test image)** ,

"determining if a stopping criterion has been met and if the criterion has not been met (224), substituting, in at least one of said groups, for at least one of said

selected images a different image in the designated collection (228) and repeating said calculating to start another iteration (216, 220)" **(Sahiner, section 1, paragraph 4, lines 1-13, section 2.4, paragraphs 1-3; The combination of Takeo and Sahiner teaches the use of linear discriminant analysis with stepwise feature selection [LDA_{sfs}] where one feature is entered into or removed from the selected feature pool at each step for analyzing its effect on the selection criterion, and further teaches the use of Wilks lambda or the Mahalanobis distance algorithm as commonly used measures. The combination of Takeo and Sahiner also teaches using [LDA_{sfs}] by applying the Wilks lambda algorithm wherein the algorithm determines if a stopping criterion is met [no more feature can satisfy the criteria for either being added or removed], and substituting in a group one of selected features [at step s of the algorithm available features are entered into the selected feature pool one at a time and those already selected are removed one at a time] and repeating said calculating to another iteration [significance of the change is rated and those that are most significant features are kept])**.

Consider Claim 5:

The combination of Takeo and Sahiner teaches "the apparatus of claim 4, said apparatus being configured for performing the steps of assigning to each of said images in the designated collection a respective number (204); selecting from among said numbers (208); and assembling bit strings representative of the

selected numbers to form a plurality of composite bit strings corresponding to respective ones of said groups (212, 304, 308)” **(Sahiner, section 2.5, paragraphs 1-2; Sahiner teaches applying genetic algorithms (GA) for feature selection, wherein assigning to each of said images in the designated collection a respective number [each image is represented by a chromosome, corresponding to the set of selected features in that that image, the chromosome comprising of genes, corresponding to each individual feature] selecting from among said numbers [the classifier can select each chromosome, and likewise can select each gene] and assembling bit strings [each gene is represented by a bit, with a 1 indicating its selection and 0 indicating that the feature is not selected] representative of the selected numbers to form a plurality of composite bit strings corresponding to respective ones of the said groups [chromosomes are composite bit strings of genes corresponding the feature set that is selected])**.

Consider Claim 6:

The combination of Takeo and Sahiner teaches “the apparatus of claim 5, said processor being configured to change, in performing said substituting, at least one bit of at least one of the plural composite bit strings to form at least one additional composite bit string in a manner that does not change at least one bit string that served as a component in said assembling (312, 316)” **(Sahiner,**

section 2.5.2, paragraphs 1-2; processor being configured to change by substituting at least one bit [crossover rate is 0.9 and is the probability parents will exchange genes] of the plural composite bit strings [chromosomes] to form one additional composite bit string [chromosomes did exchange genes] in a manner that does not change at least one bit string that served as a component in assembling [0.1 is non-crossover rate, leaving 10% as original to the chromosome pool provided]).

Consider Claim 7:

The combination of Takeo and Sahiner teaches “the apparatus of claim 5, wherein the assembling concatenates representative bit strings in forming the composite bit strings (304, 308)” **(Sahiner, section 2.5.2, paragraphs 1-2; assembling concatenates [length of chromosome is determined by the encoding mechanism and is equal to the total number of features] representative bit strings [features or genes] in forming composite bit strings [chromosomes])**.

Consider Claim 8:

The combination of Takeo and Sahiner teaches “the apparatus of claim 5, wherein said substituting comprises selecting from among the composite bit strings and changing at least one bit of a selected one of the composite bit strings to form at least one additional composite bit string (228, 312, 316)”

(Sahiner, section 2.5.2, paragraphs 1-2; processor being configured to change by substituting at least one bit [crossover rate is 0.9 and is the probability parents will exchange genes] of the plural composite bit strings [chromosomes] to form one additional composite bit string [chromosomes did exchange genes]).

Consider Claim 9:

The combination of Takeo and Sahiner teaches “the apparatus of claim 5, wherein said substituting comprises the step of swapping bits between a pair of the composite bit strings (404, 408, 412, 416)” **(Sahiner, section 2.5.2, paragraphs 1-2; swapping bits [crossover allows for exchange of genes between parents to produce two offspring, while mutation rate determines the probability that the binary value will be randomly altered as in the probability that genes will undergo mutation] between a pair of composite bit strings [chromosomes])**.

Consider Claim 10:

The combination of Takeo and Sahiner teaches “the apparatus of claim 5, wherein the substituting in said at least one of said groups comprises the step of choosing at least one of the reference images at random for said substituting (228)” **(Sahiner, section 2.5.1, paragraphs 1; The combination of Takeo and Sahiner teaches that during the training of the GA, each image was chosen**

at random to leave out as the test image in the training set for that particular image).

Consider Claim 11:

The combination of Takeo and Sahiner teaches “the apparatus of claim 1, said processor being configured to compute the distances as Mahalanobis distances (216)” **(Takeo, column 34, lines 10-67, column 35, lines 1-25, Figure 13; a Mahalanobis distance algorithm is applied to alter the groups [pattern classes for both normal and abnormal patterns] to determine which of the groups is at a minimum distance to the test image)**.

Consider Claim 12:

The combination of Takeo and Sahiner teaches “the apparatus of claim 1, comprising a random number generator for selecting at random in performing the selecting from among the reference images (208)” **(Sahiner, section 2.5, paragraphs 1-2, section 2.5.2, paragraphs 1-2; random number generator for selecting at random in performing the selecting from among the reference images [chromosomes of the selected parents are allowed to randomly cross and mutate introducing new genes and new chromosomes into the population until it evolves to a better solution; increase in fitness of the chromosomes starts to stagnate after a number of generations and the stopping criterion determines when evolution is terminated])**.

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Consider Claim 13:

Takeo teaches "A method for comparing a test medical, multi-featured image of a tumor" **(Takeo, column 6, lines 14-21, column 7, lines 6-49)** "to a collection (204) of reference medical, multi-featured images of tumors determined to be malignant, or to a collection (204) of reference medical, multi-featured images of tumors determined to be non -malignant (112, 220)" **(Takeo, column 8, lines 12-61, equation 8, steps 1-3; collection of featured images of tumors determined to be non-malignant [pattern classification between the normal pattern of i=1] or determined to be malignant [and the abnormal pattern of i=2])**, "to identify ones of the reference images that are similar feature-wise to the test image each of the features of the test and medical images having respective values," **(Takeo, column 8, lines 46-67, column 9, lines 1-12)**, "said method comprising the steps of: a) designating one of the two collections (204)" **(Takeo, column 19, lines 24-51, column 20, lines 22-66, Figures 1 and 2; processing means for designating one of the two collections [prospective abnormal pattern detecting apparatus, comparison means])**; "and c) applying a distance algorithm to alter ones of the groups and to determine which of the groups is at a minimum distance to the test image based on said values (216, 220, 224, 228)" **(Takeo, column 34, lines 10-67, column 35, lines 1-25, Figure 13; a Mahalanobis distance algorithm is applied to alter the groups [pattern**

classes for both normal and abnormal patterns] to determine which of the groups is at a minimum distance to the test image).

Takeo does not teach said method comprising “b) selecting reference images from the designated one to form respective groups of the selected images (208); and c) applying a genetic algorithm to alter ones of the groups and to determine which of the groups is at a minimum distance to the test image based on said values (216, 220, 224, 228)”.

Sahiner, however, does teach said method comprising “b) selecting reference images from the designated one to form respective groups of the selected images (208)” **(Sahiner, section 2.1, paragraph 2, lines 1-13, section 2.2, paragraph 1, lines 1-7, section 2.4, paragraphs 1-2, Figures 2 and 3; selecting reference images [255 mammograms with 128 benign and 127 malignant] to form respective groups [benign and malignant] of the selected images and designate a subset [select a subset of features from the feature pool for the classification task])**; and “c) applying a genetic algorithm to alter ones of the groups and to determine which of the groups is at a minimum distance to the test image based on said values (216, 220, 224, 228)” **(Sahiner, section 2.51-2.52, section 2.6, paragraphs 4-5)**.

It would have been obvious to a person with ordinary skill in the art at the time of the invention to combine the teachings of Takeo with Sahiner in order to apply a “GA-based method to design a high-sensitivity classifier for CAD applications” that overcomes the accuracy issues with traditional distance-based algorithms,

and that can detect masses with an accuracy “significantly higher than that of LDA_{sfs} above a true-positive fraction of 0.95” and which can provide accurate assessment of benign masses without missing malignancies **(Sahiner, section 5, paragraph 1)**.

Consider Claim 14:

The combination of Takeo and Sahiner teaches “the method of claim 13, wherein the distances are Mahalanobis distances (216)” **(Takeo, column 34, lines 10-67, column 35, lines 1-25, Figure 13; a Mahalanobis distance algorithm is applied to alter the groups [pattern classes for both normal and abnormal patterns] to determine which of the groups is at a minimum distance to the test image)**.

Consider Claim 15:

The combination of Takeo and Sahiner teaches “the method of claim 13, wherein the step b) forms a set of said groups (212) and wherein the step c) iteratively derives (228), from groups of the set, based on distances from the test image to respective ones of the groups of the set and until a stopping criterion is met (224), new groups of the set” **(Takeo, column 34, lines 10-67, column 35, lines 1-25, Figure 13; Sahiner, section 1, paragraph 4, lines 1-13, section 2.4, paragraphs 1-3; Both Takeo and Sahiner teach the use of distance**

algorithms. Takeo teaches iteratively applying a Mahalanobis distance algorithm to form a set of groups [pattern classes for both normal and abnormal patterns]; Sahiner teaches the use of linear discriminant analysis with stepwise feature selection [LDA_{sfs}] where one feature is entered into or removed from the selected feature pool at each step for analyzing its effect on the selection criterion, and further teaches the use of Wilks lambda or the Mahalanobis distance algorithm as commonly used measures. Sahiner also teaches using [LDA_{sfs}] by applying the Wilks lambda algorithm wherein the algorithm derives new groups of the set from the current groups of the set [at step s of the algorithm available features are entered into the selected feature pool one at a time and those already selected are removed one at a time] based on distances from the test image to respective ones of the groups of the set [significance of the change is rated and those that are most significant features are kept] until a stopping criterion is met [no more feature can satisfy the criteria for either being added or removed]).

Consider Claim 16:

The combination of Takeo and Sahiner teaches “the method of claim 13, further comprising the steps of: assigning to each of said images in the designated collection a respective number (204);selecting from among said numbers (208); and assembling bit strings representative of the selected numbers to form a plurality of composite bit strings corresponding to respective ones of said groups

(212, 304, 308)” **(Sahiner, section 2.5, paragraphs 1-2; Sahiner teaches applying genetic algorithms (GA) for feature selection, wherein assigning to each of said images in the designated collection a respective number [each image is represented by a chromosome, corresponding to the set of selected features in that that image, the chromosome comprising of genes, corresponding to each individual feature] selecting from among said numbers [the classifier can select each chromosome, and likewise can select each gene] and assembling bit strings [each gene is represented by a bit, with a 1 indicating its selection and 0 indicating that the feature is not selected] representative of the selected numbers to form a plurality of composite bit strings corresponding to respective ones of the said groups [chromosomes are composite bit strings of genes corresponding the feature set that is selected]).**

Consider Claim 17:

The combination of Takeo and Sahiner teaches “the method of claim 13, wherein the step c) further comprises the steps of: d) calculating, based on said values and for each of the groups” **(Takeo, column 32, lines 47-67, column 33, lines 1-67, column 34, lines 1-10, Figure 13; The combination of Takeo and Sahiner teaches calculating five index values which represents the variance, difference entropy, correlation, inverse difference moment, sum entropy to help determine if a mass is a true or false positive)** “for which a

Mahalanobis distance has not already been calculated, a Mahalanobis distance between the test image and that group (216, 220)" **(Takeo, column 34, lines 10-67, column 35, lines 1-25, Figure 13; The combination of Takeo and Sahiner teaches iteratively deriving by calculating the Mahalanobis distance between the test image and that group [pattern classes for both normal and abnormal patterns] to determine which of the groups is at a minimum distance to the test image)**;e) determining if a stopping criterion has been met (224); and f) if the criterion has not been met, substituting, in at least one of said groups, for at least one of said selected reference images a different reference image in the designated collection (228), and returning to step d) (216)" **(Sahiner, section 1, paragraph 4, lines 1-13, section 2.4, paragraphs 1-3; The combination of Takeo and Sahiner teaches the use of linear discriminant analysis with stepwise feature selection [LDA_{sfs}] where one feature is entered into or removed from the selected feature pool at each step for analyzing its effect on the selection criterion, and further teaches the use of Wilks lambda or the Mahalanobis distance algorithm as commonly used measures. The combination of Takeo and Sahiner also teaches using [LDA_{sfs}] by applying the Wilks lambda algorithm wherein the algorithm determines if a stopping criterion is met [no more feature can satisfy the criteria for either being added or removed], and substituting in a group one of selected features [at step s of the algorithm available features are entered into the selected feature pool one at a time and those already**

selected are removed one at a time] and repeating said calculating to another iteration [significance of the change is rated and those that are most significant features are kept]).

Consider Claim 18:

The combination of Takeo and Sahiner teaches “the method of claim 17, further comprising the steps of: assigning to each of said images in the designated collection a respective number (204);selecting from among said numbers (208); and assembling bit strings representative of the selected numbers to form a plurality of composite bit strings corresponding to respective ones of said groups (212, 304, 308)” **(Sahiner, section 2.5, paragraphs 1-2; Sahiner teaches applying genetic algorithms (GA) for feature selection, wherein assigning to each of said images in the designated collection a respective number [each image is represented by a chromosome, corresponding to the set of selected features in that that image, the chromosome comprising of genes, corresponding to each individual feature] selecting from among said numbers [the classifier can select each chromosome, and likewise can select each gene] and assembling bit strings [each gene is represented by a bit, with a 1 indicating its selection and 0 indicating that the feature is not selected] representative of the selected numbers to form a plurality of composite bit strings corresponding to respective ones of the said groups [chromosomes are composite bit strings of genes corresponding the**

feature set that is selected]); "wherein said substituting in step f) comprises the step of changing at least one bit of at least one of the plural composite bit strings to form at least one additional composite bit string in a manner that does not change at least one bit string that served as a component in said assembling (312, 316)" **(Sahiner, section 2.5.2, paragraphs 1-2; processor being configured to change by substituting at least one bit [crossover rate is 0.9 and is the probability parents will exchange genes] of the plural composite bit strings [chromosomes] to form one additional composite bit string [chromosomes did exchange genes] in a manner that does not change at least one bit string that served as a component in assembling [0.1 is non-crossover rate, leaving 10% as original to the chromosome pool provided])**.

Consider Claim 19:

Takeo teaches "A computer program product having a computer-readable medium that contains a computer program executable by a processor (100)" **(Takeo, column 19, lines 24-51, column 20, lines 22-66, Figures 1 and 2)**, said program for comparing a test medical, multi-featured image of a tumor" **(Takeo, column 6, lines 14-21, column 7, lines 6-49)** "to a collection (204) of reference medical, multi-featured images of tumors determined to be malignant, or to a collection (204) of reference medical, multi-featured images of tumors determined to be non -malignant (112, 220)" **(Takeo, column 8, lines 12-61,**

equation 8, steps 1-3; collection of featured images of tumors determined to be non-malignant [pattern classification between the normal pattern of i=1] or determined to be malignant [and the abnormal pattern of i=2]), "to identify ones of the reference images that are similar feature-wise to the test image, each of the features of the test and medical images having respective values" **(Takeo, column 8, lines 46-67, column 9, lines 1-12)**, "said program comprising: a) a sequence of instructions for designating one of two collections (204) ; "b) a sequence of instructions for selecting reference images from the designated one to form respective groups of the selected images (208); and c) a sequence of instructions for applying a genetic algorithm to alter ones of the groups and to determine which of the groups is at a minimum distance to the test image based on said values (216, 220, 224, 228).

Takeo does not teach "b) a sequence of instructions for selecting reference images from the designated one to form respective groups of the selected images (208)" **(Takeo, column 19, lines 24-51, column 20, lines 22-66, Figures 1 and 2; processing means for designating one of the two collections [prospective abnormal pattern detecting apparatus, comparison means])**; "and c) a sequence of instructions for applying a distance algorithm to alter ones of the groups and to determine which of the groups is at a minimum distance to the test image based on said values (216, 220, 224, 228)" **(Takeo, column 34, lines 10-67, column 35, lines 1-25, Figure 13; a Mahalanobis distance algorithm is applied to alter the groups [pattern classes for both**

normal and abnormal patterns] to determine which of the groups is at a minimum distance to the test image).

Sahiner, however, does teach "a computer program product having a computer-readable medium that contains a computer program executable by a processor (100)" **(Sahiner, section 2.1, paragraphs 3-4)** "said program comprising: b) a sequence of instructions for selecting reference images from the designated one to form respective groups of the selected images (208)" **(Sahiner, section 2.1, paragraph 2, lines 1-13, section 2.2, paragraph 1, lines 1-7, section 2.4, paragraphs 1-2, Figures 2 and 3; selecting reference images [255 mammograms with 128 benign and 127 malignant] to form respective groups [benign and malignant] of the selected images and designate a subset [select a subset of features from the feature pool for the classification task])**; and "c) a sequence of instructions for applying a genetic algorithm to alter ones of the groups and to determine which of the groups is at a minimum distance to the test image based on said values (216, 220, 224, 228)" **(Sahiner, section 2.51-2.52, section 2.6, paragraphs 4-5)**.

It would have been obvious to a person with ordinary skill in the art at the time of the invention to combine the teachings of Takeo with Sahiner in order to apply a "GA-based method to design a high-sensitivity classifier for CAD applications" that overcomes the accuracy issues with traditional distance-based algorithms, and that can detect masses with an accuracy "significantly higher than that of LDA_{sfs} above a true-positive fraction of 0.95" and which can provide accurate

assessment of benign masses without missing malignancies **(Sahiner, section 5, paragraph 1)**.

Conclusion

7. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure.

Takeo, Hideya, US 20020062075 A1, Prospective abnormal shadow detecting system, and method of and apparatus for judging whether prospective abnormal shadow is malignant or benignant.

Boroczky; Lilla et al., US 20090148010 A1, False positive reduction in computer-assisted detection (CAD) with new 3D features.

Giger, Maryellen L. et al., US 20010043729 A1, Method, system and computer readable medium for an intelligent search workstation for computer assisted interpretation of medical images.

Takeo; Hideya, US 20070019848 A1, Prospective abnormal shadow detecting system and method of and apparatus for judging whether prospective abnormal shadow is malignant or benignant.

Okada; Kazunori et al., US 20060050958 A1, System and method for volumetric tumor segmentation using joint space-intensity likelihood ratio test.

Nakamura, Keigo, US 20050265606 A1, Method, apparatus, and program for detecting abnormal patterns.

Matsui, Koh, US 20050201599 A1, Diagnostic imaging support apparatus and diagnostic imaging support method.

Takeo, Hideya et al., US 20050036669 A1, Method, apparatus, and program for detecting abnormal patterns.

Takeo, Hideya et al., US 20040081343 A1, Abnormal pattern candidate detection processing method and system.

Garrelli, et al., "Automatic diagnosis with genetic algorithms and case-based reasoning", Artificial Intelligence in Enginerring, 13 (1999), p. 367-372.

Golobardes et al., "Computer-aided diagnosis with case-based reasoning and genetic algorithms" Knowledge-Based Systems, 15 (2002), p. 45-52.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to TAHMINA ANSARI whose telephone number is (571)270-3379. The examiner can normally be reached on Monday through Thursday, 8:00 AM to 5:00 PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, NABIL EL-HADY can be reached on 571-272-3963. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

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